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UNITED STATES.

*Report on leprosy in the Hawaiian Islands, November 29, 1898, by Surgeon
D. A. Carmichael, U. S. M. H. S.*

[Detailed by the President for duty at Honolulu, in accordance with the act of Congress approved February 15, 1893, with instructions to make a special report on leprosy.]

Origin.—A number of statements are made relative to the introduction of leprosy into the Sandwich or Hawaiian Islands. Some contend that the disease was brought by the natives themselves, who are an offshoot of the great Polynesian race, the Mahori branch, that inhabit the islands that lie to the south and west. It has existed in the islands of Malaysia for ages and in Java and other islands of the great archipelago.

There is a record that in 1778 a Hawaiian chief named Kahaina visited China, and it is also stated that there was communication between the natives and those inhabiting other islands in Polynesia as far back as the twelfth century. In 1798 the North Pacific whaling fleet began to visit the Sandwich Islands and in subsequent years made Lahaina on the island of Maui and Honolulu or Oahu their principal ports of call, and it is claimed that leprosy was brought here by the mixed crews—negroes, black and white Portuguese, and Chinese, of the whalers. In 1810 the Hawaiians began to export sandalwood to Chinese ports in foreign-built vessels.

In a report made to the Hawaiian board of health in 1886 by Dr. Arthur Moritz, the physician in charge of the leper settlement on Molo-kai, it is stated that one of the earlier missionaries in Honolulu who came to the Hawaiian Islands in April, 1823, the Rev. Chas. S. Stew-

art, recorded in his diary a few weeks after his arrival : " Not to mention the frequent and hideous mark of a scourge which more clearly than any other proclaims the curse of a God of purity ; and which, while it annually consigns hundreds of this people to the tomb, converts thousands while living into walking sepulchres. The inhabitants generally are subject to many disorders of the skin, and the majority are more or less disfigured by eruptions and sores, and many of them are as unsightly as *lepers*."

On July 4 of the same year the same observer notes : " Indeed we seldom walk out without meeting many whose appearance of misery and disease is appalling, and some so remediless and disgusting that we are compelled to close our eyes against a sight that fills us with horror. Cases of ophthalmic scrofula and elephantiasis are very common."

The Rev. W. P. Alexander, who came here in 1833, states that the first case of leprosy that he saw on the islands was in a native Hawaiian on the island of Maui, and that he heard several years before that a chieftess in Lahaina, on the same island, was affected with the disease.

Mr. Brickwood, a resident of these islands in 1840, and who had been familiar with the appearance of leprosy in Egypt, recognized the disease in a native in Honolulu.

In Dr. Alonzo Chapin's description of the islands, published in the American Journal of the Medical Sciences in July, 1838, is the following : " Foul ulcers of many years standing, both indolent and phagedenic, everywhere abound, and visages horribly deformed, eyes rendered blind, noses entirely destroyed, mouths monstrously drawn aside from their natural positions, ulcerating palates, and almost useless arms and legs mark most clearly the state and progress of the disease among that injured and helpless people."

The descriptions given by the Rev. Mr. Stewart and Dr. Chapin were intended to describe the ravages of syphilis, which had been introduced among the natives by the white sailors who first visited these islands, but the pictures presented might with equal force apply to leprosy, foul ulcers of many years standing being common in ulcerating tubercular leprosy, and the distorted visages and useless arms and legs being common in the anæsthetic type of the disease. According to Dr. Hillebrand, leprosy was introduced into Honolulu by the Chinese in 1848, and he claims to have seen the first Hawaiian leper five years later ; ten years later the disease had spread considerably in the immediate neighborhood of this case, and it is possible that the Chinese carried the disease to other points in the islands.

Mr. R. W. Meyer, for many years agent of the Hawaiian board of health at the leper settlement on Molokai, in his report for 1886 states that he arrived at the islands in 1850, that in 1857 he first heard of the appearance of leprosy among the natives, and that in 1859 or 1860 he saw the first case of leprosy in a young native who died with it in less than three years. The young man's mother took care of him, and

probably in 1868, she showed signs of leprosy, and died a leper at the settlement. The Chinese generally get the credit for its introduction, although this is denied by many observers, and it is a singular fact that few Chinese on these islands have the disease in comparison with the large number of cases which have occurred among the native Hawaiians.

Restrictive measures.—A board of health was first organized on December 14, 1850, by the order of King Kamehameha III to aid in the preservation of the public health and for the cure of contagious, epidemic, and other diseases, and more especially cholera. Until the close of 1863 and the beginning of 1864 no measures were taken by the Kingdom of Hawaii for the suppression of leprosy. At the beginning of 1864 the spread of the disease in Honolulu and other places in the islands had awakened public apprehension and in 1865 the legislature of the Kingdom of Hawaii enacted a law to prevent its spread. The act is here quoted in full in order to show the authority relative to segregation conferred by it.

AN ACT TO PREVENT THE SPREAD OF LEPROSY, 1865.

WHEREAS, The disease of leprosy has spread to considerable extent among the people, and the spread thereof has excited well-grounded alarms; and, whereas further, some doubts have been expressed regarding the powers of the board of health in the premises, notwithstanding section 302 of the civil code; and, whereas, in the opinion of the assembly section 302 is properly applicable to the treatment of persons afflicted with leprosy; yet, for greater certainty and for the sure protection of the people,

Be it enacted by the King and the legislative assembly of the Hawaiian Islands in the legislature of the Kingdom assembled:

SECTION I. The minister of the interior, as president of the board of health, is hereby expressly authorized, with the approval of the said board, to reserve and set apart any land, or portion of land, now owned by the government, for a site or sites of an establishment or establishments to secure the isolation and seclusion of such leprosy persons as in the opinion of the board of health or its agents may, by being at large, cause the spread of leprosy.

SEC. II. The minister of the interior, as president of the board of health, and acting with the approval of the said board, may acquire, for the purpose stated in the preceding section, by purchase or exchange, any piece or pieces, parcel or parcels of land, which may seem better adapted to the use of lepers than any land owned by the government.

SEC. III. The board of health or its agents are authorized and empowered to cause to be confined in some place or places for that purpose provided, all leprosy patients who shall be deemed capable of spreading the disease of leprosy, and it shall be the duty of every police or district justice when properly applied to for that purpose by the board of health or its agents, to cause to be arrested and delivered to the board of health or its agents, any person alleged to be a leper, within the jurisdiction of such police or district justice, and it shall be the duty of the marshal of the Hawaiian Islands and his deputies, and of the police officers, to assist in securing the conveyance of any person so arrested to such place, as the board of health, or its agents may direct, in order that such person may be subjected to medical inspection,

and thereafter to assist in removing such person to a place of treatment, or isolation, if so required by the agents of the board of health.

SEC. IV. The board of health is authorized to make such arrangements for the establishment of a hospital where leprous patients, in the incipient stages, may be treated in order to attempt a cure, and the said board and its agents shall have full power to discharge all such patients as it shall deem cured, and to send to a place of isolation, contemplated in Sections I and II of this act, all such patients as shall be considered incurable or capable of spreading the disease of leprosy.

SEC. V. The board of health or its agents may require from patients such reasonable amount of labor as may be approved of by the attending physicians, and may further make and publish such rules and regulations as by said board may be considered adapted to the condition of lepers, which said rules and regulations shall be published and enforced as in sections 284 and 285 of the civil code provided.

SEC. VI. The property of all persons committed to the care of the board of health, for the reasons above stated, shall be liable for the expenses attending their confinement, and the attorney-general shall institute suits for the recovery of the same when requested to do so by the president of the board of health.

SEC. VII. The board of health, while keeping an accurate and detailed account of all sums of money expended by them out of any appropriations which may be made by the legislature, shall keep the amounts of sums expended for the leprosy distinct from the general account. And the said board shall report to the legislature at each of its regular sessions, the said expenditure in detail, together with such information regarding the disease of leprosy, as well as the public health generally, as it may deem to be of interest to the public.

Approved this 3d day of January, 1865.

KAMEHAMEHA.

Station at Kalihi.—On November 13, 1865, a hospital with suitable buildings was established and opened at Kalihikai on the island of Oahu and distant from Honolulu about 3 miles. This station was designed for the reception, inspection, and treatment of persons afflicted with leprosy. Mild cases after the diagnosis had been made were to be treated here and the more severe or incurable cases were to be transferred to the site recently purchased at Kalawao on the island of Molokai. On the opening day 62 persons were present for examination, and inspection found among this number 43 lepers. In 1866, according to the reports furnished the Government, the number of lepers on the different islands of the group was as follows :

Hawaii	75
Maui, Molokai and Lauai.....	112
Oahu	80
Kauai and Niihau.....	7
Total.....	274

This hospital was maintained until 1875, when it was abolished and a house in town on Nunanu street substituted. During its existence about 40 lepers died there, some 10 deserted, and many passed through its portals to the leper settlement on Molokai.

There was no marked change in the condition of affairs for some years, the system of mild segregation was kept up and the number of lepers examined and sent to Molokai varied from year to year. There was a marked increase in the number sent to the settlement in the years 1869, 1871, 1873, 1875, and 1878. In 1881 the receiving station for lepers, as it was then called, was removed to Kakaako, a suburb a mile to the southwest of Honolulu. On November 5, 1885, the Queen Kapiolani Home was opened, near the receiving station, for the reception of nonleprous female children of leprous parents. In 1889 the receiving station was once more removed to its present situation and not far from its original site in 1865, at Kalihi, called Kalihi-Punhale. Up to 1887 all lepers and suspects examined at the receiving station were passed upon by one physician, but in that year a medical board of three was appointed. All of the suspects reported to the board of health were taken to this station from the different islands in the group and examined by this board. At the present time there are six physicians on this board and each is required to record his individual diagnosis and all must agree before a suspect is consigned to Molokai. This station now comprises buildings for the reception of suspects and treatment of lepers, offices, dispensary, bacteriological laboratory for the special study of leprosy and other contagious diseases, and on the west side of the reservation, some distance from the other buildings and isolated by high palings, is the Queen Kapiolani Home for the female nonleprous children born of leprous parents, which is under the charge of the Sisters of Charity. All of the scientific examinations of lepers and much of the experimental treatment is performed at this station, and is under the immediate charge of Dr. L. F. Alvarez, who has an international reputation as a skilled leprologist.

Lepers settlement on Molokai.—In September, 1865, the spit of land on the northern or windward side of the island of Molokai was chosen as a suitable site for the establishment of a settlement for the segregation of lepers. The site is probably one of the most suitable and isolated that could have been chosen for such a purpose. It is surrounded on the north, east, and west by the sea, and the base or southern side is placed beneath a steep pali or precipice, from 1,800 to 2,000 feet high, which discourages communication with the rest of the island. Near the center of this tongue of land is the extinct crater of Kahukoo, 493 feet above the sea level, which, when active, formed with the erosion from the adjacent mountains and valleys the plain on which the settlement is now located. This plain has an area of about 8 square miles, and its breadth at the base where it joins the mountain chain is $2\frac{1}{2}$ miles, at the center, $2\frac{1}{2}$, and seaward or northward, about 1 mile. The soil is composed of lava rock, disintegrated lava and ocean sand, and with abundance of water is like most soils of volcanic origin—very fertile.

The first settlement was at Kalawao on the eastern side of the spit of land. It lies in close to the mountains at the rear and is much exposed

to the northeast trade winds. Kalaupapa, the more recent and larger settlement, is situated on the plain to the westward, is further removed from the steep cliffs, and is somewhat protected from northeast winds by the crater of Kahukoo. The shore on the eastward is rugged and difficult of access. On the westward it is easier of approach and has more shelter. One and three-quarters miles seaward of Kalaupapa is the small village of Ilioki, and midway between Kalaupapa and Kalawao and close in to the base of the mountain is the village of Makanaupapa, both included in the leper settlement. No trees grew originally on the plain and only coarse grass on the Kalaupapa side, but efforts have been made from time to time to plant different varieties and some success has been obtained.

The mountain range which shuts off the settlement on the island side is bold and rugged and is continued east and west the whole length of the island, reaching toward the eastward an elevation of 3,000 to 4,000 feet. Adjoining the settlement are the valleys of Waikolu and Waihaiau. Water is supplied from the Waikolu Valley and piped from thence to the settlements. Storage reservoirs are placed at different points as a reserve in case of accident to the main supply. As already noted, the site was chosen in 1865 and the settlement was opened for the reception of lepers in the following year. The first establishment was at Kalawao and here the hospital, different churches, and the Baldwin Home for leprous boys are located.

When the board of health first opened the settlement, and for many years afterwards, much difficulty was experienced from the presence of persons who owned parcels of land in this tract, and who were called Kamainas or old settlers. They were not subject to the laws governing lepers, and were free to come and go from the settlement at will. Their influence was detrimental to the discipline of the place, and associations between them and the lepers was a weak spot in the system of segregation. Communication with other parts of the island was maintained by climbing the steep trails which led up the pali at the rear of the settlement.

The Hawaiian Government has secured the property owned by these Kamainas, and they have been removed from the settlement. Molokai is probably the most complete settlement of its kind in the world. It has hospitals, churches, homes for leprous children, male and female, stores, market dispensaries, cottages for leper residents, jail, storehouses, etc. The majority of the lepers live in cottages built by themselves or by the government, and in the settlement there is a total of all buildings of 716.

The lepers are supplied with a liberal ration by the government, which for one week comprises the following: Beef, 7 pounds; salmon, 5 pounds; fresh fish, 7 pounds; pai-ai, 1 bundle, 21 pounds net (a native food prepared from the root of the colocasia esculenta, often written

“poi”) ; rice, 9 pounds, with 1 pound of sugar ; Bread, $8\frac{1}{2}$ pounds, with 1 pound of sugar ; flour, 12 pounds, with 1 pound of sugar.

Children born at the settlement, of leprous parents, receive one-half of the above ration.

Monthly rations are also issued of soap, salt, matches, and kerosene oil. Each leper, outside the homes, receives a clothes ration order of the value of \$5 every six months, on the 1st of January and July in each year. Many of the lepers have friends outside who supply them with clothes and money. The Bishop Home for leprous girls and the Baldwin Home for leprous boys draw their supplies of food directly through the board of health as required.

The cost of the settlement to the government is about \$67,000 per year, and the amount expended for segregation and transportation of lepers and maintenance of the receiving station at Kalihi amounts to about \$16,640 per annum.

The following table showing the number of lepers at the settlement on Molokai, mortality, and the number on the books at the end of each year and estimated from the report of the board of health for the biennial period ended December 31, 1897, is given below :

Year.	Admissions.	Deaths.	Discharged or unaccounted for.	Number on the books Dec. 31.
1864 (a).....	141	26	10	105
1867.....	70	25	7	143
1868.....	115	28	2	228
1869.....	126	59	11	284
1870.....	57	58	4	279
1871.....	183	51	9	402
1872.....	105	64	4	439
1873.....	487	156	21	749
1874.....	91	161	8	671
1875.....	212	163	14	706
1876.....	96	122	3	677
1877.....	163	129	1	710
1878.....	239	147	802
1879.....	125	209	1	717
1880.....	51	152	10	606
1881.....	232	132	706
1882.....	71	121	6	649
1883.....	301	150	15	785
1884.....	108	168	8	717
1885.....	103	142	26	655
1886.....	43	100	8	590
1887.....	220	108	4	698
1888.....	579	212	28	1,035
1889.....	308	149	7	1,187
1890.....	202	158	18	1,213
1891.....	143	212	2	1,142
1892.....	109	137	19	1,095
1893.....	211	151	1,155
1894.....	128	155	3	1,124
1895.....	106	128	15	1,087
1896.....	146	116	2	1,115
1897.....	124	139	1,100

a Settlement opened.

The following table, taken from the report of Dr. A. Moritz for 1866, showing the nationality, number, and sex received annually, is also given :

Table showing the nationality, number, and sex of lepers received annually at Molokai from 1866 to 1885.

Year.	Hawaiian.		Mixed Hawaiian.		White.		Chinese.		Other nationalities.		Total.
	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	
1866.....	101	38					2				141
1867.....	56	12			1				a 1		70
1868.....	72	37	2	2	1		1				115
1869.....	73	53									126
1870.....	31	26									57
1871.....	125	55	3								183
1872.....	69	36									105
1873.....	289	191	2	1			3		b 1		487
1874.....	51	37	1	1	1						91
1875.....	121	82	2	2	3		1		c 1		212
1876.....	55	39	1		1						96
1877.....	107	53	2				1				163
1878.....	134	101	1	2	1						239
1879.....	79	42	1	1	1		1				125
1880.....	31	17	2		1						51
1881.....	151	76	2		2		1				232
1882.....	49	18	1		1		2				71
1883.....	181	116	3				1				301
1884.....	60	37	3		2		6		d 1		108
1885.....	68	28	2		1		3				102
	1,903	1,094	28	9	16		22		3	1	3,075
a Roratongan.		b Mauritius.		c Manila.		d Lascar.					

The following table shows the number of persons sent to the Kalihi receiving station from the different Hawaiian Islands for examination and their pronounced condition, for the two years ended December 31, 1897. Also the number sent to the leper settlement in the same period :

Examined during period 1895 to 1897.

From island of—	Lepers.	Suspicious.	Not lepers.	Total.
Oahu.....	71	50	20	141
Hawaii.....	100	5	2	107
Maui.....	40	14	3	57
Molokai.....	10	1	2	13
Kauai.....	29	2	2	33
At Kalihi, December 31, 1895.....	19			19
Total.....	269	72	29	370

SENT TO LEPER SETTLEMENT DURING PERIOD 1895 TO 1897.

Males ..	165
Females.....	91
Total.....	256

NATIONALITIES.

Hawaiian	225
Half-caste	15
Chinese	9
Portuguese	2
German.....	2
American	1
British.....	1
South Sea Islander.....	1
Total	256
Escaped from Kalihi	3
Sent to Japan.....	3
In Kalihi at this date.....	7
Total	269

AGE OF LEPERS SENT DURING PERIOD DECEMBER 31, 1895, TO 1897.

Under ten years	10
Ten to twenty years.....	92
Twenty to thirty years	51

Visit to Molokai.—On November 11, through the courtesy of the Hon. W. O. Smith, attorney-general and president of the board of health, I accompanied the board on its semiannual visit to the leper settlement. The steamer *Mezama* of the Interisland Steamship Company, which was chartered for the purpose, left Honolulu at 9.30 p. m. on the 11th, and arrived at Kalaupapa at daylight next morning. A number of natives who were going to visit relatives at the settlement, by the permission of the board of health, were also on the steamer. The bold cliffs of the mountain range on Molokai stand out in severe lines as the steamer approaches, and nestling at the foot of the mountains on the spit of land was seen the leper settlement.

At a distance Kalaupapa looks like a prosperous little town, and in anticipation of the visit of the board of health a large number of the inhabitants had gathered at the landing place, some on foot and many mounted on horses. Some difficulty was experienced in landing, which is done by open boat, there being no docks or wharves, as there was a long northerly swell and the surf was somewhat dangerous. In the hands of natives skilled in surfboating this was soon accomplished without accident, and the entire party landed. After passing through the large crowd of lepers at the landing, and being warmly welcomed by a band of music composed of leper boys, we first visited the building set apart for the use of the board of health. Here different committees were organized for business and professional purposes. Headed by Dr. S. F. Alvarez, a number of the medical men, who accompanied the party, secured horses and rode across to the old settlement of Kalawao on the eastern side of the leper peninsula. Here were seen the different churches, Protestant, Catholic, and Mormon, including that built by Father Damien, and the grave of this leper martyr by the church side. The Baldwin Home for leprous boys was then visited, and the hospitals and cottages for the accommodation of lepers in various stages of the

disease. The buildings are arranged around an open court in the form of a quadrangle, and the well-kept lawn, trees, and shrubbery makes the place present quite a pleasing aspect. The buildings are very neat and clean, everything was found in good order, and the management of Messrs. Dutton and Van Lil was much praised.

Many cases of leprosy were seen here from the slight anæsthetic form affecting the ulnar and facial nerves to the most revolting types of ulcerating tubercular leprosy, and those who were sightless, paralyzed, bedridden, and almost moribund. Attached to the Baldwin Home is a system of baths which have rendered efficient service. Our time being limited we returned to Kalaupapa, and after lunch provided by the board, and taken ashore from the steamer, the medical experts of the board, Drs. Wood, Emerson, Alvarez, and Myers, conducted an examination of a number of persons at the settlement. Some of these claimed that the disease had disappeared and wished to return to their homes. A few children born in the settlement were also examined, and a number of kokuas, or helpers, who resided at the settlement for years, and wished to know if they had contracted the disease. The clinic was very interesting, and many of the milder types of the disease were seen. In case of doubt the patient was ordered to the receiving station at Kalihi, near Honolulu, for further examination. The Bishop Home for leprosy girls was then visited, and further examinations made here of a similar character to the others. The board having completed its business, the party boarded the steamer and returned to Honolulu.

Spread of the disease.—From 1849 to 1865 no measures were adopted by the Hawaiian authorities for the suppression of leprosy. The intimate living habits of the natives, using the same sleeping mats, clothing, pipes, eating from the same dishes, bad hygienic surroundings, and, above all, a tolerance of the leper—that is, he was treated as a member of the family and never as an outcast—are given as some of the causes aiding in its spread.

In 1852–53 an epidemic of smallpox invaded the Hawaiian Islands and over 5,000 died. Vaccination of the people resorted to during and subsequent to this epidemic is said to have aided in the dissemination of leprosy. The vaccinations, according to competent observers, were made from arm to arm, with humanized virus, and frequently the pulverized scab selected without much care. The vaccinations were done by planters, missionaries, and the natives, owing to the limited number of physicians available. The general opinion among leprologists is that vaccination had little to do with the spread of leprosy; that the disease was not common in those years, and that there was no marked increase in the number of cases, within the usual period of incubation, subsequent to the epidemic of smallpox.

During the residence of Dr. E. Arning here as a specialist to investigate leprosy for the Hawaiian Government an interesting experiment bearing on this subject was performed by him.

In 1885 he vaccinated a number of lepers. The vaccination took in 3 cases, 1 tubercular and 2 anæsthetic. Both the lymph and crust of the tubercular case contained the bacillus of leprosy, but he could not detect it in the anæsthetic cases. Nonhumanized virus has been used in the islands since 1888 and precludes the possibility of transmitting leprosy by vaccination.

During his residence here Dr. Arning also performed his now celebrated experiment bearing on the direct inoculation of leprosy. By consent of the Government and a condemned criminal named Kenan, whose sentence was commuted to imprisonment for life, Dr. Arning, on September 30, 1884, excised a leprous tubercle from the arm of a pronounced leper and transplanted it to the exterior surface of the left forearm of Kenan. He was confined and kept under daily observation for the four weeks following, and after that, once a week for several months, a microscopic examination of the inoculation spot being made each time. After this he was examined regularly once or twice a month. The microscope revealed the presence of the bacillus lepræ in large numbers until the middle of March, 1885. They then diminished in numbers but were present in the scab fourteen months after inoculation. At this time there was nothing in his appearance indicative of leprosy. Pains in the elbow and wrist of the inoculated arm, which existed in 1885, four and five months after inoculation, soon disappeared. There was no marked change in the condition of Kenan until March, 1887 (two and a half years after inoculation). Dr. Brodie, the prison physician, then noticed changes in the right ear and coppery looking spots on the right cheek. In December, 1887, he was examined by Dr. Arthur Moritz and his description given as follows: "General health good; no pain; slight unhealthy wound on palmar aspect of left index finger is the only abrasion of the skin. Covering the chest, arms, abdomen, and especially the back, is a copper-colored eruption raised above the surrounding skin and giving to the touch a distinct feeling of thickening. The size of the spots varied from a 10-cent piece to half a dollar, and present shapes round, oval, and serpiginous. The backs of the legs and thighs are affected, and on the front of the knees and thighs are serpiginous patches and small plaques. The right cheek, forehead, and right ear are infiltrated with leprous deposit. Eyebrows show no sign of diminution. The ulnar and external popliteal nerves are thickened. Kenan was afterwards removed to Molokai and died there. This experiment of Dr. Arning was widely accepted as proof of the inoculability of leprosy, but Mr. R. W. Meyer, for many years superintendent of the settlement at Molokai, states there were lepers in Kenan's family. His mother-in-law Pulu, died of leprosy in July, 1891, and Kenan's own son, Josepha, was at the leper settlement long before Kenan himself became a leper, and died there in December, 1893. Kenan's nephew, David, a son of Kenan's sister, also died of leprosy at the settlement in July, 1890."

Other modes of communication.—Kissing, nose rubbing, cohabitation, reception of the secretions from lepers on abrasions of the surface of the skin or by inhalation, deglutition, or transmission by insects. In many of the tubercular cases and some of the anæsthetic variety, the lips, cheeks, tongue, arches of the palate, and nose, are the seat of numerous leprous ulcers, and it is claimed that they also exist in the intestines. The bacilli are readily given off from these ulcers, and it is said can be communicated when a suitable soil is presented, such as abrasions of the skin and mucous membrane, catarrhal conditions, etc.

The natives eat poi, or pai-ai, from the same dish with the fingers, and a leper in the circle with digital leprous ulcers might convey it to the others.

The opinion prevails in Hawaii that the disease is not communicated by cohabitation with lepers, but leprologists admit that in the early stages of the disease, when it is not well defined on the surface of the body, leprous patches may be present on the genitals and given an abrasion or suitable soil it is reasonable to infer that transmission in this manner is not impossible.

It is suspected that certain insects play a part in the transmission of leprosy, the common house fly, mosquito, and bedbug, being the principal carriers of the infection. The house fly is now prominent as a disseminator of typhoid fever and septic affections, and it is not difficult to imagine that an active part can be taken by this insect in the spread of leprosy, particularly where they can pass from open leprous ulcers to other individuals who may present a suitable soil for the reception of the bacillus. I am not aware that any bacteriological investigations have been made in this matter relative to the house fly. The mosquito is also considered as the disseminator of certain diseases, and some light has been thrown on the influence it may have on the transmission of leprosy by Dr. L. F. Alvarez, the leprologist of the Hawaiian Government. He allowed mosquitoes to alight on the open sores of lepers, and when they had feasted themselves they were captured, killed, and stained preparations made from their crushed bodies contained leprous bacilli in large numbers. Mosquitoes are present in the Hawaiian Islands throughout the entire year. Until the life history of the bacillus leper is worked out and isolated cultures obtained, the powers of resistance of the organism to external agencies will remain unknown, but it is believed to be very resistant, and it may exist in a spore condition in the soil, on clothing or other fomites and on the surface of various articles.

In 1884 Dr. Arning made some experiments relative to the resisting powers of the bacillus of leprosy. "Leprous tissue and matter were set aside under conditions of temperature and moisture conducive to thorough putrefaction, whilst the growth of the larger fungi was carefully excluded. Microscopical examinations were made from time to time, and the bacillus lepræ was found to hold its own against the

germs of dissolution and putrefaction of albuminous matter, and was met with so abundantly and so laden with spores that the idea of actual increase suggested itself to him. Subsequent examinations showed that every vestige of the cellular and fibrous structure of the tissue had disappeared, even the bacteria of putrefaction had crumbled up into a mass of detritus, but the bacillus leprae was there with all its peculiar microchemical reactions."

Prompted by this investigation, the same observer went to Molokai and procured parts of a case of tubercular leprosy which had been buried three months and was in an advanced state of putrefaction. In this tissue the leprous bacillus was present in large numbers. Dr. L. F. Alvarez has lately made some interesting experiments bearing on the possible culture of the bacillus of leprosy. Up to the present bacteriologists taught that the bacilli of leprosy could be distinguished from many other bacilli by the fact that they were not decolorized by strong solutions of the mineral acids.

After many experiments he succeeded in demonstrating the existence of leprous bacilli, which are entirely decolorized when washed in solutions of 25 per cent of sulphuric or in 30 per cent of nitric acid. He states that he has never found the decolorized bacilli in old tubercles or ulcerating surfaces. They are found only in recent eruptions or new nodules, and are probably the young or active bacilli, while the bacilli which hold the stain are probably old and inert. He states that this discovery may serve to explain the many failures in producing pure cultures in artificial media. If the tubes are inoculated from old tubercles failure results, as the bacilli are dead or have lost their power of reproduction, and if he found colonies of bacilli in his tubes which did not stain he would probably throw them away. He also states that he has lately obtained growths of bacilli, resembling those of leprosy in blood serum. They are decolorized by mineral acids and the growth is almost invisible. The only sign of growth is a glazed appearance of the surface inoculated. They appear to grow only on the surface of the serum and do not form colonies. A mongoose inoculated with these bacilli showed slight paralysis of the hind legs and died in a few days after, but the examination did not reveal the cause of death.

Immunity —All persons are not susceptible to leprosy, and most of the white race seem to have a certain immunity, and if the disease can be conveyed by cohabitation the white sailor seems secure. Many women have lived in intimate relation with leprous husbands and husbands with leprous wives, and failed to contract the disease. A number of the kokuas or helpers on Molokai have lived among and associated with lepers for years and escaped.

Bearing on this question, Dr. A. Moritz gives the following: "The washwoman for the hospital at Kalawao has washed the soiled clothes of lepers, the worst cases, for seventeen years, she had lepers living in her house, and her two husbands were lepers for years before they died,

and yet in spite of all this contact this woman is hale, hearty, and plump, and as fine a specimen of womanhood as any in the islands." Such cases must possess a certain immunity which is wanting in others.

The native Hawaiian seems more susceptible to the disease than any other race at present on the islands and a glance at the statistical tables already given will confirm this statement.

The population of the Hawaiian Islands as given February 8, 1897, was as follow :

Nationality.	Males.	Females.	Total.
Hawaiian	16, 399	14, 620	31, 019
Part Hawaiian.....	4, 249	4, 236	8, 485
American	1, 975	1, 111	3, 086
British.....	1, 406	844	2, 250
German.....	866	566	1, 432
French.....	56	45	101
Norwegian	216	162	378
Portuguese.....	8, 202	6, 989	15, 191
Japanese.....	19, 212	5, 195	24, 407
Chinese	19, 167	2, 449	21, 616
South Sea Islanders.....	321	134	455
Other nationalities.....	448	152	600
	72, 517	36, 503	109, 020

The present census of the leper settlement on Molokai, taken on November 11, 1898, is as follows :

Leper males, 634 ; leper females, 439 ; total, 1,073. Detail, Baldwin Home, boys, 141 ; detail, Bishop Home, girls, 130. Nonleprous children of leprous parents, male, 43 ; nonleprous children of leprous parents, female, 18 ; total, 61. Helpers (kokuas), nonleprous persons permitted by the board of health to live in the settlement and care for leprous relatives, etc., males, 37 ; females, 36 ; total, 73. Nonleprous priests, sisters, brothers, teachers, etc., 61 ; total of all persons at the settlement, November 11, 1898, 1,207.

Heredity.—At one time much importance was attached to the theory of heredity in this place but in the light of the present day it is considered an exploded theory. A person has only to visit the Kapiolani Home at Kalihi and see the healthy female children born in the settlement of leprous parents, (one or both lepers) and ranging in age from three to twenty years, to be convinced that there is little in the theory of heredity. In contrast with this and an additional argument in favor of contagion is the fact that if these children, born of leprous parents, and without a blemish, be left with their parents and associate with lepers they contract the disease.

A home for boys born of leprous parents is now under consideration, and a small appropriation has been made by the Government for that purpose. In connection with subject, and in the absence of prohibitive measures relative to the cohabitation of lepers, those best informed here

say that the fertility of lepers is not great and that many of the progeny of such die in early childhood of diseases other than leprosy.

Prevailing types of the disease.—The two principal types seen here are the tubercular and anæsthetic, and sometimes a mixed form. The tubercular form is the most abundant and exceeds the anæsthetic variety by three or four to one. It is characterized by the presence of tubercles on the face and other parts of the body, infiltration of the cheeks, nose, forehead, and lobes of the ears. The eyebrows are lost and the countenance assumes a leonine expression. There is thickening of the fingers and toes, swelling of the hands, feet, and limbs, and leprosy patches on the chest, abdomen, back, and nates. It hardly ever attacks the scalp. In the anæsthetic variety, the favorite points of attack are the facial, ulnar, and peroneal nerves. The nerve sheath is invaded by the bacilli, the trunk of the nerve is thickened and perceptibly enlarged. There may or may not be leprosy patches on the body and possibly leprosy ulcers in the mouth or nose, but these are more common and severe in the tubercular forms. Paralysis and wasting of the muscles follow, and there are peculiar deformities of the hands and feet, palmar and planter ulcers often form. The anæsthetic type is slow in progress and may last for many years. In the severe forms of leprosy, the fingers, toes, and even the limbs are lost, the eyes are destroyed, all of the viscera and tissues of the body are gradually invaded, and the leper dies a revolting mass of humanity. Skin diseases are very common among lepers here, and in the early stages interfere with the diagnosis.

Medical treatment.—The Hawaiian Government with a liberality which is deserving of high praise, has made every effort to employ different measures vaunted as cures for leprosy. Their own physicians have tried many remedies, and in 1883 Dr. Edward Arning, of Switzerland, was induced to come to Hawaii and serve the Government as a specialist to investigate the subject of leprosy. He accomplished much in the line of investigation, but little relative to curative treatment. He resigned in 1889, and was succeeded in the same year by Dr. A. Lutz, of San Paulo, Brazil, a pupil of Dr. Unna, of Hamburg.

Under the influence of good food, improved hygienic surroundings and treatment of a tonic nature, the disease improves and sometimes is arrested, in a manner similar to cases of tuberculosis, but the tendency to relapse is great and the cases of aborted leprosy are not numerous. Among the medicinal remedies most valued here are, sodium salicylate, salol, creosote, gurgun and chalamoogra oils, pyrogallie acid, chrysarobin, ichthyol, lysol and mercurials in cases associated with syphilis.

Dr. Alvarez has tried a bouillon prepared from a culture of the bacillus prodigiosus used as an injection once daily, beginning with 12 c.c. and increasing gradually until 80 c.c. were used.

This was tried in 12 leper boys brought from the settlement at Molokai, and the experiments extended over a period of three months.

At the end of the period the boys were examined by the medical board and 2 of them declared free from leprosy and returned to their homes. Another showed marked improvement, but the condition of the others was not changed. He also tried thymus and thyroid glands extract and dry powder. The result was negative in the case of the thymus, but from the thyroid gland were satisfactory. He has also tried the serum of Dr. Carrasquilla of Bogota, Colombia. Temporary improvement in all and marked benefit in one case resulted, which continued for six weeks, "the tubercles which had covered his face, ears, and chest had, with very few exceptions, disappeared entirely." Baths of various kinds, including the Goto system, have also been tried. They are all beneficial, but not curative.

Dr. F. R. Day, port physician, and member of the Hawaiian board of health, who visited Japan in 1897, informs me that the Kusatsu Springs in that country have a beneficial and curative effect in leprosy. These waters contain the sulphates of aluminum, iron, calcium, magnesium, soda, and potash, and have a large percentage of free hydrochloric and sulphuric acids.

An imitation of the waters of these springs was tried here, but without any positive results. The moxa has also been used to destroy the tubercles, and with good results. The curative treatment of leprosy has up to the present yielded meager results. Hawaii presents a suitable field for the scientific study and investigation of leprosy.

Present outlook.—The Hawaiian authorities have accomplished much in their efforts to prevent the spread of leprosy in the face of the difficulties they have had to contend with, the principal of which has been the indifference and want of cooperation on the part of the native race, who are the most susceptible to the disease.

In the past segregation has been abhorrent to them, they do not fear leprosy, and cases are concealed from the authorities as long as possible. It has been stated to me, by one in a position to know, that in spite of the efforts to segregate lepers, many are still at large on the different islands. Segregation has now been practiced in a manner since 1866, a period of thirty-two years, and should have produced more positive results in diminishing the number of cases.

The number of cases at Molokai at the present time shows no great diminution when compared with former years, but in explanation of this the authorities state that the large number is due to stricter methods of segregation observed since the fall of the monarchy and that the number of cases at large is few compared with former years.

The humane and praiseworthy method of providing for the care of lepers at Molokai has made the place attractive to some of the natives, and it is said that many try to acquire the disease in order that they may live at Molokai at the expense of the Government for the rest of their days.

Stricter segregation is demanded and intercourse between those un-

affected and the settlement should be prohibited or allowed under more rigid methods of procedure, which would prohibit actual mingling with those diseased. Cohabitation with or between lepers should be prohibited. House-to-house inspection at proper intervals has never been practiced, and the buildings and effects of lepers have not been disinfected or destroyed. Importation of races from endemic areas of leprosy should be conducted only under the most rigid system of inspection, restricted, or prohibited, and cremation of the bodies of the dead from leprosy should be practiced.

Precautions necessary to prevent the introduction of leprosy into the United States from the Hawaiian Islands.—The period of incubation in leprosy is so long and variable, from three to seven or ten years, its detection in the early stages so difficult, and the fact that leprous patches may first appear on the unexposed parts of the body, such as the upper parts of the arms, chest, back, and nates, and that leprous ulcers may be present in the upper part of the nasal passages, makes its detection by ordinary quarantine methods uncertain.

In pronounced cases detection is easy, but these rarely emigrate and the greatest difficulty would be met with in the slight cases occurring in the white or mixed races.

The native Hawaiian rarely emigrates, and those who leave their homes generally go as sailors, although I have been informed that there is a small colony of Hawaiians in Salt Lake, Utah, who were induced to go there by the Mormon missionaries. Inquiry as to the presence or absence of leprosy among them would be interesting.

It is possible for persons with leprosy undeveloped, and for the slighter cases, to pass from one country to another without detection, and the fact of its presence in various parts of the United States is evidence that quarantine restrictions do not exclude it.

Few medical men are familiar with the appearance of leprosy in its early stages, and cases are often diagnosed as other skin diseases, and the fact that skin diseases such as psoriasis, various forms of taenia, chloasma, scabies, erythema, etc., are often associated with leprosy, makes its detection still more difficult.

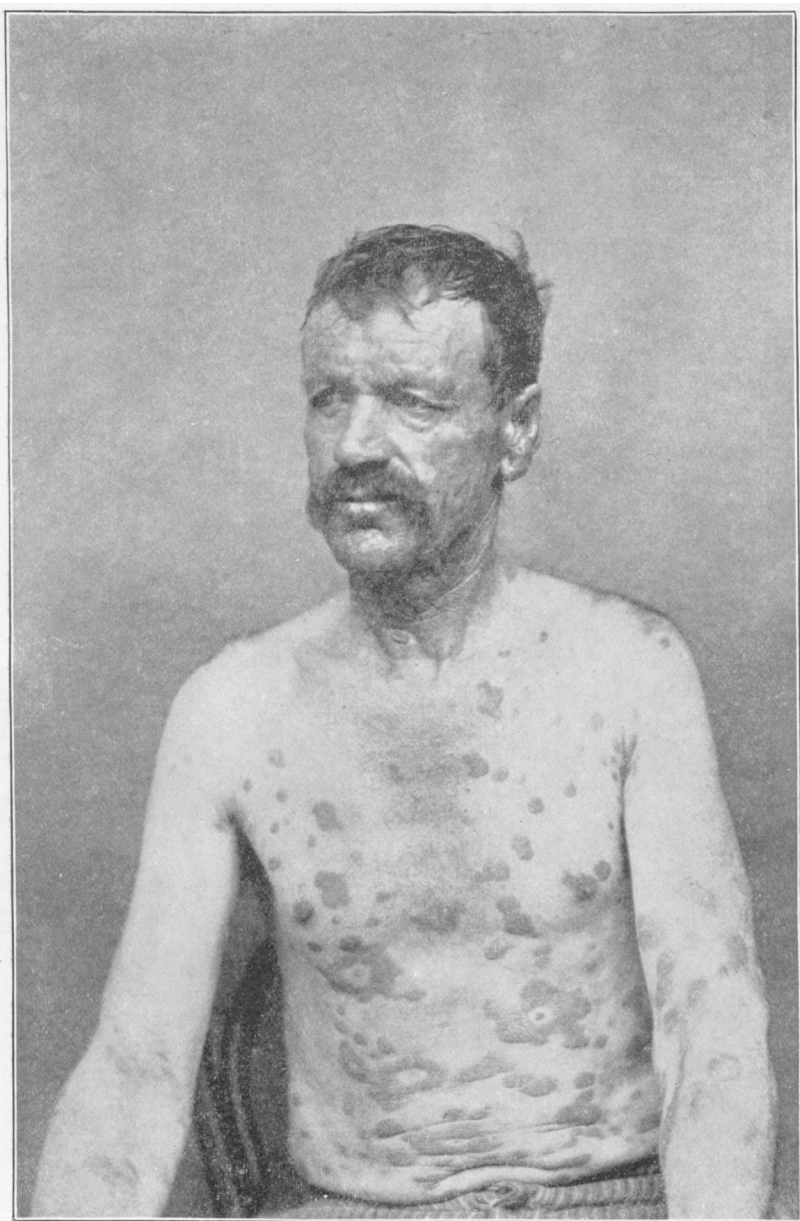
Restrictive measures should be adopted to control the departure of all emigrants from endemic foci of leprosy at the point of departure, and these should consist of a careful inquiry into the family and sanitary history of each emigrant, a rigid physical examination and disinfection of his effects. Similar procedures at the port of arrival should be adopted and a record of the destination of the emigrant preserved.

Adoption of the above-named measures would restrict the importation of the disease so far as it is possible to do so, but such proceedings could be still further aided by the Government of the United States assuming control of measures for the suppression of leprosy in the possessions recently acquired by annexation and by conquest, viz, the Hawaiian

and Philippine Islands and the Island of Cuba, in all of which leprosy exists to a greater or less extent.

In so doing it would assume its share among the nations in stamping out this pest of ages, and would set an example which might, with undoubted benefit to the welfare of mankind, be emulated by the enlightened nations of the world.

I am indebted to the Hon. W. O. Smith, attorney-general of Hawaii, president of the board of health, the medical members and the executive officer, Mr. C. B. Reynolds, for many favors.



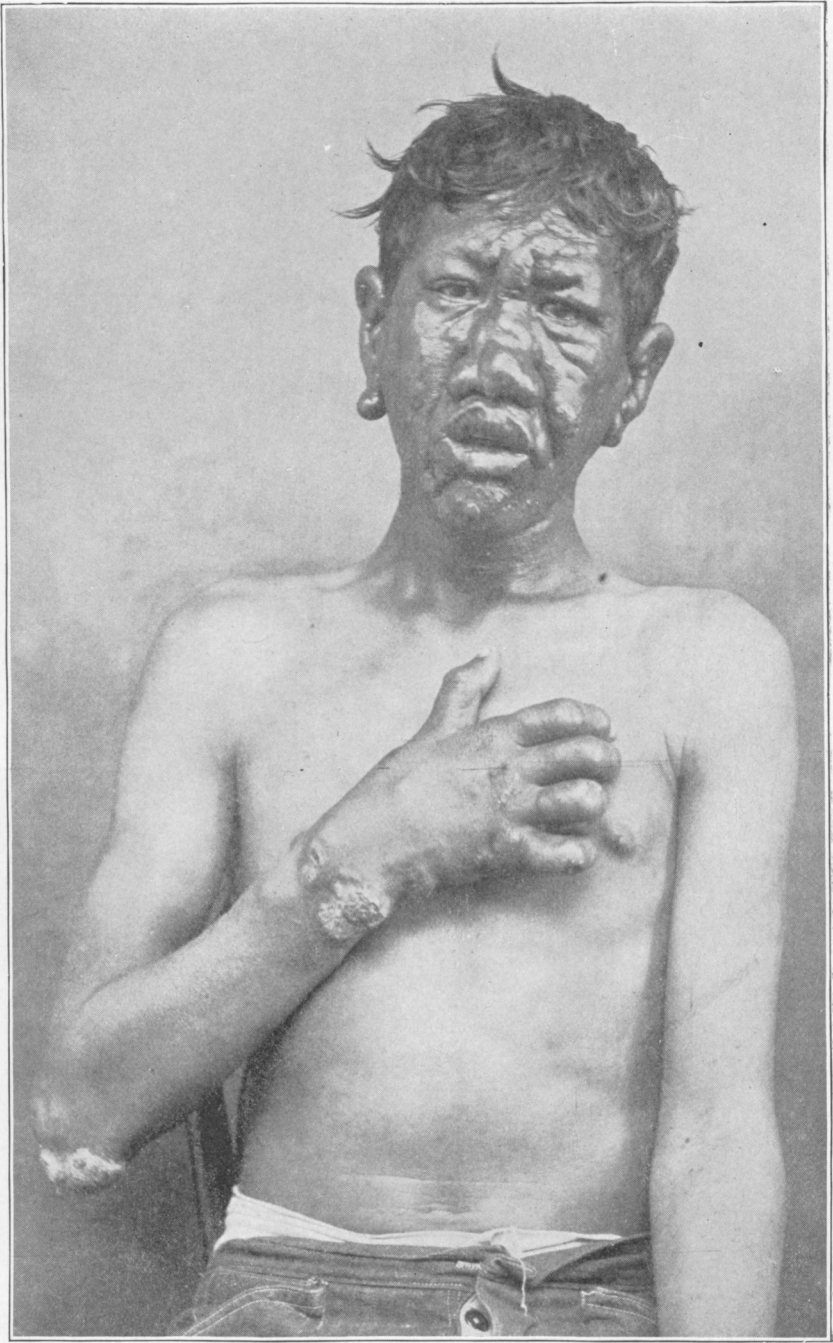
No. 1. MUSCULAR LEPROSY.



No. 2. ANÆSTHETIC LEPROSY—LOSS OF FINGERS AND TOES.



No. 3. TUBERCULO-ANÆSTHETIC LEPROSY, SHOWING THE "LEONINE" COUNTENANCE.



No. 4. TUBERCULOUS LEPROSY.